PROGRESS REPORT
ON
COMPUTER APPLICATION TO SYSTEM ANALYSIS

LOWER MEKONG RIVER

Prepared by
Mark L. Nelson and David M. Rockwood
for the
U. S. Agency for International Development

October 1964

U. S. ARMY ENGINEER DIVISION, NORTH PACIFIC

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PROGRESS REPORT

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I. SUMMARY

1. In order to provide those readers whose time is limited with a condensed version of the salient features of this report a summary is made. For complete details on the salient items and other aspects associated with the work of the survey team the full text is commended to the reader.

2. Arrangements were made by the Department of State, Agency for International Development, Washington, D. C., with the Director of Civil Works, Office, Chief of Engineers, U. S. Army, Washington, D. C., for a survey team, consisting of Mr. Mark L. Nelson, Chief of the Water Control Branch, U. S. Army Engineer Division, North Pacific, Portland, Oregon, and David M. Rockwood, Hydraulic Engineer (Research) of the same office, to follow up on the proposal of the State Department to the Committee for Coordination of Investigations of the Lower Mekong Basin for the conduct of the training program in System Analysis. This survey is to determine the progress that has been made in this particular area subsequent to the report made by Messrs. Nelson and Lewis, dated July 1963, for AID on Computer Application to System Analysis, Lower Mekong River.

3. The mission of the team was divided into three principal parts as follows:

a. To interview and to determine the qualifications of the proposed candidates and to ascertain if they would benefit from the system analysis training program.

b. To obtain assurances, which will later be confirmed in the project agreement, from the Mekong Committee that adequate computer facilities will be provided in Bangkok to make the necessary systems analyses.

c. To review the work being carried out by Société Grenobloise d'Études et d'Applications Hydrauliques (SOGREAH) at Grenoble, France, to insure the compatibility of the mathematical Delta Model and the proposed System Analysis project to the computer facilities in Bangkok.

4. The Curriculum Vitae for three candidates from Thailand and one from Viet Nam were submitted to the team when it was in Bangkok. Only one of the candidates was able to be made available for interview. In the opinion of the team the four riparian countries, exclusive of Cambodia, can nominate a sufficient number of candidates for training in the System Analysis program who are adequately educated and trained technically. The qualifications of each candidate on the comprehension of English, both oral and in writing, should rest with AID. Each candidate should have an 85 percent proficiency in English, both oral and written, in accordance with AID's standards. Before any candidates are accepted for training their technical qualifications should be reviewed by the Corps of Engineers.

5. At the time of the review by the Survey Team in the spring of 1963, as reflected by the report dated July 1963 on Computer Application

to System Analysis, Lower Mekong River, certain statements were made as to the availability of a given computer complex in Bangkok. On physically reviewing these facilities in September 1964 it was determined that the IBM 1620 computer at the Chulalongkorn University had not been expanded to the intended degree. To expand these facilities to the degree necessary to handle the System Analysis Computer Program would require a capital outlay for purchase of additional computer facilities for the existing IBM 1620 in the order of $150,000. The National Statistical Office of the Government of Thailand is seriously considering expanding their facilities from an IBM 1401 system to something larger. They have in mind an IBM 360. The best solution to the computer problem would be for the Mekong Committee to make arrangements with the National Statistical Office to rent computer time on the 360, thereby assisting that office in supporting and justifying an enlarged computer system. This procedure would eliminate the capital outlay and would make available to the Mekong Committee staff a computer entirely adequate to handle all the programs allied with the System Analysis Program.

6. SOGREAH at Grenoble, France, is making satisfactory progress on the program for the mathematical Delta Model and when completed it will be written in FORTRAN and will be compatible to the Bangkok computer system - IBM 360. SOGREAH plans to debug and prove out their computer program on an IBM 360 system to be installed during the spring of 1965 in Paris. In addition, SOGREAH has on order an IBM 360 and committed date for installation at Grenoble is the fall of 1965. When the System Analysis Program reaches the stage where the program for the

Lower Mekong and the Delta are to be coupled together, arrangements should be made for a qualified representative of SOGREAH to be present in the North Pacific Division office to assist with this complex task. Also, conversely, it would be desirable for a qualified representative from the Corps to assist SOGREAH when it couples the Lower Mekong Model and the Delta Model together on the computer at SOGREAH.

II. INTRODUCTION

7. Authority. - Pursuant to an exchange of letters between the Director of Civil Works, Office, Chief of Engineers, U. S. Army, Washington, D. C., and the Department of State, Agency for International Development, Washington, D. C., dated 3 June 1964 and 8 August 1964, a survey team, consisting of Messrs. Mark L. Nelson, Chief of the Water Control Branch, U. S. Army Engineer Division, North Pacific, Portland, Oregon, U.S.A., and David M. Rockwood, Hydraulic Engineer (Research) of the same office, were designated to follow up on the proposal of the State Department to the Mekong Committee for the conduct of the training program in System Analysis. This team is to follow up on the recommendations contained in the report on Computer Applications to System Analysis, Lower Mekong River, prepared by Messrs. Nelson and Lewis for the U. S. Agency for International Development, dated July 1963. Copies of the referenced exchange of letters are attached as Appendix A to this report.

8. Terms of Reference. - The terms of reference for the survey team, as given in the referenced letter of 8 August 1964, were as follows:

a. To interview the proposed participants to determine that their professional qualifications are consistent with Chapter VIII, Training, paragraph 82, page 46, of the Nelson and Lewis Report, and to determine that the proposed participants would benefit from a systems analysis training program.

b. To obtain assurances, which will later be confirmed in the project agreement, from the Mekong Committee that the existing computer facilities in Bangkok will be available, modified and used in accordance with Chapter VII, Evaluation of Bangkok Computer Facilities, pages 37-43, and Chapter X, Conclusions and Recommendations, paragraph 100, page 54. . . . .

c. To review the work being carried out by SOGREAH at Grenoble, France, to insure the compatibility of the mathematical Delta Model and the proposed Systems Analysis project to the computer facilities in Bangkok.

9. Itinerary and Contacts. - Tokyo, Japan. - On 5 September 1964 the team departed for Bangkok and stopped enroute at Tokyo, Japan, and Taipei, Taiwan, before arriving at Bangkok. The locations at which stops were made and the individuals contacted are shown by Appendix B of this report. At Tokyo the individuals contacted were mainly members or former members of the Japanese Reconnaissance Team which prepared reports on the overall development of the Mekong. The purpose of the discussions with them was to determine whether or not there had been any significant change in their concepts as to the overall plan of development for the Mekong as given in their early reports, and since

our discussions with them on this same subject in April 1963. The discussions disclosed that there has not been any major change in their concept of system development for the Mekong. Another aspect which was discussed with them was the possibility of expanding the training program to include nationals from countries other than the Mekong riparian countries. They are definitely interested in the training of engineers from Japan in the concepts of system analyses techniques. The person of prime interest to be contacted in this event is Mr. Ni-i-nomi of the Overseas Technical Cooperation Agency and a member of the Japanese Reconnaissance Team.

10. It is pertinent to mention that the Japanese Electric Power Development Co., Ltd., are using the IBM 7070 electronic computer for business and engineering types of work. They are fast outgrowing this computer and plan to expand later to an IBM 360.

11. Taipei, Taiwan. - Discussions were held with engineers of the Taiwan Power Company at Taipei, Taiwan 10 to 13 September. Certain of the projects of the Taiwan Power Company were visited. They are quite progressive in their engineering and planning and have an interest in the Mekong River Development because Mr. Cheng-Fong Hsu, Vice-President of the Taiwan Power Company, is also presently Director of the Taipower Technical Mission to Viet Nam in connection with the development of certain power resources to serve Saigon. The Taiwan Power Company has an IBM 1620 and is actively using this computer in connection with certain engineering applications and problems.

12. During the time the team was in Taipei, Mr. P. T. Tan, Chief, Division of Water Resources Development, ECAFE, was in the city on business not associated with the Mekong. We spent several hours with Mr. Tan discussing certain technical aspects of a systems analysis project associated with the pending meeting of the Mekong Committee. Mr. Tan was scheduled to return to his office in Bangkok on 21 September.

13. Bangkok, Thailand. - The team arrived in Bangkok, Thailand, late on the evening of 14 September. On 15 September the team reported to Mr. William J. Tonesk, U. S. Liaison Officer to ECAFE, at the American Embassy. The team advised Mr. Tonesk of its mission and plans, and discussed in some detail with him the terms of reference associated with the assignment. Further contacts in Bangkok with numerous individuals are more directly related to the ensuing Section III and will be discussed in greater detail under that section. Others contacted under the terms of reference related to participants in the training program will be discussed under Section V. In addition, there was considerable discussion with Dr. D. Zanobetti, of UNESCO, Paris, France, who is Manager for UNESCO on the mathematical model for the Mekong Delta by SOGREAH of Grenoble, France. These discussions will be covered under Section VI.

14. New Delhi, India. - The team arrived in New Delhi, India, early on the morning of 27 September. A meeting was held on 28 September in the office of Mr. P. R. Ahuja, Chief Engineer and Joint Secretary, Ministry of Irrigation and Power. Also present were Messrs. Pritam Singh and K. V. Krishnamurthy of the Central Water and Power Commission.

The discussions centered around the report entitled "Tonle Sap Barrage Project, Report on Designs and Costs Estimates" of which Mr. Ahuja is the Project Manager. The interest of the team in the Tonle Sap Project is keen in that this project is one of the major elements of the main stem and will provide a certain degree of flood control to the Mekong Delta and other ancillary benefits to the Grand Lake. The computer program for reconstituting flows of the Mekong and its tributaries, as well as for forecasting the river, when completed will be most helpful to the Indian engineers in working out the hydrology of the Tonle Sap project. Of particular value is its use for developing operating rule curves for flood control and other purposes.

15. Grenoble, France. - The team arrived in Grenoble, France, on 4 October 1964 and met with representatives of SOGREAH on 5 October 1964. Although Mr. H. Lorgeré is the Engineer in Charge of the Mekong Delta Program, he reports to Mr. Francis Biesel, who is Director of the Scientific Division. Discussions were also held with Messrs. Preissman, who is the Chief Computer Programmer of the Mekong Delta Model, and Mr. Cunge, Programmer on the Mekong Delta Model. The discussions were mutually beneficial and enlightening. SOGREAH has made excellent progress on the development of the Delta mathematical model. Details associated with this subject are covered at some length under Section VI.

16. Paris, France. - On 9 October the team met with Professor D. Zanobetti at his office in UNESCO, Paris, France. He is Project Manager for UNESCO on its contract with SOGREAH for development of the program for the mathematical model of the Mekong Delta. The model and associated

details were discussed in considerable detail, which was mutually beneficial to all concerned. Further discussion on this subject is covered under Section VI.

17. Washington, D. C. - The team arrived in Washington, D. C. on 11 October 1964, and met with personnel of the Office, Chief of Engineers, Civil Works Division, and personnel of the State Department associated with the Training Program and the AID Office of SE Asia Affairs.

18. List of Personnel Contacted. - For all the personnel contacted and visited at the several locations please refer to Appendix B, which gives in detail the locations, dates and names of individuals contacted.

III. U. S. SYSTEM TRAINING PROGRAM PROPOSAL TO MEKONG COMMITTEE

19. Prior Action U. S. Position. - The U. S. position on the Training Program for System Analysis as a result of the report by Messrs. Nelson and Lewis, dated July 1963, on this subject was announced at the 23rd Plenary of the Mekong Committee held in Bangkok, Thailand, 7-13 January 1964. This position was further reiterated by letter of the Agency for International Development, U. S. Operations Mission to Thailand, dated 16 January 1964, to Dr. C. Hart Schaaf, Executive Agent, Committee for Coordination of Investigations of the Lower Mekong Basin. A copy of this letter, together with the reply thereto dated 13 February 1964 by Dr. C. Hart Schaaf, is attached as Appendix C.

20. U. S. Position at 25th Session. - The subject of System Analysis was an item on the Agenda for the 25th Session of the Coordinating Committee for their formal action. Attached as Appendix D is the Provisional

Agenda. Mr. William J. Tonesk, U. S. Liaison Officer to ECAFE, presented the U. S. position on the System Analysis Training Program. A copy of his remarks is included as Appendix E. With respect to his remarks, certain reservations and assurances were noted as conditions for the U. S. proceeding with the program. For ready reference these qualifications are quoted as follows:

> "1. Making available five or six suitable candidates, including two hydrologists, for a year's training at the Portland Center. Candidates should include nationals from all four riparian countries (see para. 81 & 82 of the System Analysis Report).
>
> "2. That the Committee intends to pursue a continuing program of system analysis after the training is completed (see para. 85), that the engineers trained by the Corps of Engineers will be assigned to the System Analysis program for at least three years after completion of their training (see para. 101) and that the trainees will train replacements if they should leave their positions thereafter.
>
> "3. That the Committee will work out with the Thai Government effective arrangements, preferably in writing, for the modification and use of the computer facilities in Bangkok as discussed in Section VII and para. 100. We assume that the costs of modifying or adding to the existing computer facilities for system analysis use will be part of the Mekong Committee or Thai contribution to the project."

At the conclusion of Mr. Tonesk's presentation he called on Mr. Mark Nelson to further elaborate on the program. A copy of Mr. Nelson's prepared statement is attached as Appendix F. For ready reference the significant aspects of Mr. Nelson's remarks as directly related to the Training Program are quoted as follows:

"It is desired to amplify some of the statements made by Mr. Tonesk to stress the importance of these points as related to system analysis

through the use of an electronic computer. The items I have in mind in particular are:

"(a) The obtaining of all possible precipitation and streamflow records for all stations throughout the basin.

"(b) The obtaining of the Computer Program developed by SOGREAH under contract to UNESCO for a mathematical model of the Mekong Delta, together with all supporting data as program write-up, logic statements, flow chart or diagram and other relevant information.

"(c) The continued diligent prosecution of the Committee staff and others on the collection and compilation of basic data as envisioned by the Committee in its Five Year Program and Financial Plan for 1964/68 under U. N. Special Fund Institutional Support Project. Information in this category includes, for example, project layouts, cost estimates, mapping, geologic and foundation data, patterns of irrigation diversion extent and amounts, return flow, minimum flow requirements for the several purposes to be served, including that required for navigation and salt-water intrusion, power market surveys regional and potential world markets, and data on which to base or measure the benefits to be realized through the several functions to be served to permit an overall economic analysis and the determination of a benefit-cost ratio for the project or projects of the system.

"With your indulgence I would like to discuss in some detail each item. Streamflow, of course, is basic to any system analysis of a series of multiple purpose projects. A longer record should be used for analysis than that which is presently available for the Lower Mekong Basin and its tributaries, as the result of the program initiated through the Contract with Harza and since continued by the four riparian countries and the Committee staff. For this work you are to be complimented. We, however, must develop a period of record for about 25 years. This we feel can be done by use of the computer program or model of the river which we will create for you and train your engineers in the use of this new tool. To go back in time, however, we must, and I repeat must, have all the daily hydrologic data available--precipitation, streamflow and river gage height--for all stations.

"The computer program developed by UNESCO thru SOGREAH we must have, together with all its supporting data, so that we can couple the two mathematical models together into one, so that flows and stages for the entire river, including the Delta, can be developed. This coupling together of the two models is essential to permit your engineers on their return home to make flood forecasts on a daily basis throughout the flood season. It also will permit complete analysis to be made of the effects of the Great Lake, either with or without the Tonle Sap project. The combined model can be used to test many things insofar

as determination of flows and their regulation by any given combination of projects.

"The reason for special recognition and emphasis to the basic data collection and analysis is that on the return of your engineers, they will need these data to make more meaningful system analyses and to better determine the effects when any given variable is changed or modified. I know you are all aware of the importance of this work, but I would be remiss if I didn't emphasize it here. More refined data I am sure will permit you to develop an overall basin plan that is comprehensive in nature, where all the pieces dovetail together. It also should permit you to select some of the smaller projects requiring less capital expenditure, but fitting into the overall basin plan and then leaving the larger ones requiring greater capital outlay for later development as your over-all economy grows to the degree necessary to require the development of the larger projects. Work in the basic data field must be relentlessly continued and pursued."

21. Committee Action on U. S. Training Proposal. - The Chairman of the Committee, Dr. Binson, polled the four riparian countries separately, and asked for their comment. All of the countries were in favor of accepting the Training Program for System Analysis and the proposal was accepted by a unanimous vote of the Committee. It was apparent, however, that Cambodia probably would not send any candidates to the U. S. for training. Thailand indicated a willingness, in the event there was a shortage of trainees to meet the required quota, to furnish additional candidates to meet the desired number of 6 to 8 engineers.

22. Team Activity on Drafting Agreement. - Certain events took place prior to and subsequent to the meeting which had a bearing on the Training Program for System Analysis. These events will be discussed in order in the paragraphs to follow.

23. Although the team reported to Bangkok early in the week of September 14, 1964, some of the key people at ECAFE headquarters, who

were concerned with the program and who were actively engaged in the formulation of the Training Program at the time of the preparation of the July 1963 report, were absent from their offices, namely, P. T. Tan and Roger Berthelot. Work did proceed, however, on other aspects associated with the program. A considerable amount of this work was in collaboration with Mr. William Stephens of USOM. Based on the assumption that the program would be accepted by the Committee, the team prepared drafts of appropriate parts of the formal agreement to be entered into between USOM and the Lower Mekong Coordinating Committee. Also, drafts of appropriate parts of the Project Implementation Order for Technical Services and Project Implementation Order for Participants were prepared and left with Mr. Stephens. It is anticipated that further assistance can be rendered to USOM by the team in preparing the final drafts.

24. Review of Qualifications for Training. - On 16 September a meeting was held in Dr. Schaaf's office amongst Dr. Schaff, Mr. Kanwar Sain, Mr. William Tonesk, Mr. William Stephens, and the team, to discuss the Training Program in general. The discussions centered primarily around the ability of the candidates to adequately understand not only the technical aspects of the program but also their ability to comprehend English. On the latter aspect there is concern by the team on the ability of the trainees to adequately understand English. The Corps of Engineers possesses the necessary capability to undertake a successful training program, but if the training candidates, be they completely qualified technically, do not understand and comprehend English to the required degree, the program could fail miserably. The team is of the

strong opinion that the United States should not be placed in this position. Dr. Schaaf, however, had some reservations in this regard. He felt that the candidates, with some initial knowledge of English, augmented by a very intensive three-months' training program of at least 12 hours a day, could overcome the English language barrier.

25. Subsequent discussions on this particular subject with others, namely, Dr. Ittipon Phadungcheewit, Professor in Charge of University Computer Center, Chulalongkorn University, Dr. Bundhit Kantabutra, Secretary-General, National Statistical Office, Dr. D. Zanobetti, Mr. P. T. Tan, and American professors at SEATO Graduate School of Engineering, indicate that all candidates for the training program should have an 85 percent proficiency on the speaking and understanding of English in accordance with the criteria and tests established by the State Department. The team strongly feels that in addition to technical qualifications, the English qualification, as cited, must be met by each candidate through oral and written tests by the State Department.

26. Hydrologic Aspects of Training Program. - The importance of the hydrologic aspect of the Training Program cannot be over-emphasized, because the reconstitution of stream flows for the Lower Mekong and its principal tributaries for a period of about 30 years is the basic ingredient for System Analysis. It is cited in the 1963 report that all of the precipitation data throughout the entire basin which can be obtained must be made available. This aspect in particular was reflected in a memorandum dated September 18, 1964 by Mr. Nelson to Messrs. Tonesk

and Stephens. A copy of this memorandum is attached as Appendix G. These facts were made known in writing by Mr. Tonesk to Dr. Schaaf, Executive Agent of the Committee. This information is in addition to that data obtained by the Harza Engineering Company and subsequently carried on by the Mekong Committee. The streamflow and hydrologic program established must be continued with diligence. This is being done. In regard to past records, both for precipitation and stream gage heights, these subjects were discussed with an assistant of Mr. Berthelot's, namely, Mr. Packeo Saycocie, prior to Mr. Berthelot's return during the week of 21 September, and after that by Mr. Rockwood with Mr. Berthelot. It is the opinion of the team that sufficient precipitation records for a long enough period of time are available to reconstitute the flows. To do so, however, will require obtaining certain special equipment to photograph and microfilm the records in the four riparian countries. As discussed with Mr. Berthelot, this equipment can be obtained for a reasonable cost, and each of the riparian countries will have to be visited to microfilm all of the precipitation records and other pertinent data. This work should be accomplished prior to sending any candidates to the States for training. To give an idea of the extent of importance and significance of the hydrologic training program as a part of the System Analysis Training Program, a preliminary outline of the Training Program and a brief description of this program is attached as Appendix H.

27. Participation by Committee Staff. - It is important that the Hydrologic Training program and Flow Reconsitituion get off to a good

start. In order to fulfill this objective it is the concensus of the team and also others concerned that for the first three months of the Hydrology Training Program Mr. Roger Berthelot accompany the trainees to initiate this aspect of the program. This will afford Mr. Berthelot, of the Committee Staff, an opportunity to obtain a detailed working knowledge of the streamflow synthesis computer program, as well as to gain a concept of the overall system analysis program.

IV. COMPUTER FACILITIES REQUIRED IN BANGKOK FOR SYSTEM ANALYSIS

28. Review of Existing Computer Facilities. - In the report dated July 1963 on Computer Application to System Analysis for the Mekong River, it was brought out that certain modifications were required to the existing IBM 1620 system at Chulalongkorn University to enable it to handle system analysis programs. It was discovered by the team that the present computer at the University has a deficiency in memory and other factors over what was reported in the July 1963 report. To increase the capability of the 1620 system at the University to the required degree for system analysis would cost about $150,000.

29. New Computer Outlook. - The computer facilities and program of the National Statistical Office of the Government of Thailand were discussed with Dr. Bundhit Kantabutra, the Secretary-General of that office. The problem was also discussed with Mr. Everett Kimball, Jr., a computer specialist of USOM/Thailand, assigned to assist the National Statistical Office Secretary General with his computer programs and problems.

30. The subject of the computer needs of the National Statistical Office and appraisal thereof also was discussed with Mr. L. L. Hunt, Jr., General Manager of the IBM Thailand Co., Ltd., Bangkok. His specific views on this subject are reflected by his letters dated 25 September 1964 and 8 October 1964. Copies of these letters are attached as Appendix I.

31. Change in Computer Concept for System Analysis. - It is apparent to the team and to others concerned that the best solution for the required computer configuration to accomplish any given system analysis in Bangkok after completion of the training program would be to do such work on an IBM 360/40 system or equivalent that has "built in" hardware (not a compiler) that will accept a computer program written in FORTRAN with little or no loss in efficiency. It is the obligation of the Mekong Committee or the Government of Thailand to provide the necessary computer facilities, either by modification or some other appropriate means. A joint effort of the Committee and the National Statistical Office through the use of an IBM 360 system is the logical solution. In the absence of such a procedure the only other logical alternative would be to modify the present 1620 system at Chulalongkorn University at a cost of some $150,000. The latter procedure is not deemed advisable, not only because of the cost, but also because of the fact that the IBM 360 possesses many advantages over the 1620 system. The 360 system is of new generation concept, is much faster and is capable of doing many times more computing than is presently being done by the National Statistical Office on its present 1401 system at very little,

if any, additional cost. Furthermore, programming for the 360 system is universally in FORTRAN with little or no loss in efficiency on the main frame computer. With an estimated workload on system analysis by the Mekong Committee of 40 hours per month, at an estimated rental cost of about $50,000 per year, three years' support, as a minimum, of the 360 system in the National Statistical Office could be gained without exceeding the cost of modifying the present IBM 1620 system at the University, neglecting any hourly charge for use of the University computer configuration.

32. Suggested Computer Approach. The Committee joining hands with the National Statistical Office in support of an IBM 360/40 system or equivalent is a very logical event. In addition, with the two-year delivery schedule quoted by IBM the timing would be excellent insofar as the Training Program is concerned.

V. CANDIDATES PROPOSED FOR TRAINING

33. Candidates' Records. - One of the terms of reference of the team's assignment was to interview proposed candidates and determine their qualifications. Curriculum vitae for three candidates from Thailand and one from Viet Nam were submitted to the team. These qualifications are set forth in Appendix J attached.

34. Mr. Chanchai Wongthai - Thailand. - Only one candidate, Mr. Chanchai Wongthai, was available for an interview. A transcript of his college record was also made available to the team and showed some aptitude in hydraulics. Before this candidate is considered further

it would be necessary for him to meet the 85 percent rating on his English examination, both oral and in writing, as determined by the requirements of the State Department, and as heretofor described in Section III.

35. Mr. Chanvorapab - Thailand. - The curriculum vitae of Mr. Sompong Chanvorapab appears to be acceptable from a technical standpoint, although his experience in hydrologic or hydraulic work appears limited. Before accepting this candidate it would be necessary for him to meet the stipulated English requirements of 85 percent.

36. Mr. Weesakul - Thailand. - The curriculum vitae of Mr. Wera Weesakul, even though he has specialized more in structural engineering, indicates that he would make a good candidate, particularly in the event he passes the test on English proficiency. His curriculum vitae, however, shows that he speaks English fluently, but this would be subject to verification by State Department test.

37. Mr. Le Long - Viet Nam. - The information pertaining to Mr. Le Long of Viet Nam is limited, but it appears conceivable that he could be a good candidate. It is pertinent to mention at this point that it is desirable to have at least one of the hydrologic engineer candidates to be an individual who has had training in connection with the development of the mathematical model of the Mekong Delta by SOGREAH at Grenoble, France. Although the team requested SOGREAH to make Mr. Le Long available for interview at the time of our visit to

Grenoble, through the turn of events SOGREAH inadvertently failed to do so.

38. Review of Qualifications. - It is the opinion of the team that a sufficient number of candidates can be made available for training, who possess adequate technical qualifications. The biggest imponderable relative to their qualifications is their proficiency in speaking and understanding English. As cited in the 1963 report on the System Analysis Program, it is highly desirable for the candidates to possess not only a good academic background in the desired technical area, but also it is preferable that they have some experience in the hydrologic and hydraulic area dealing with the programming of the use of water to serve multiple-purpose needs from a storage reservoir or a series of reservoirs. Equally important is their capability of speaking and, in particular, of understanding English with a proficiency of at least 85 percent, as determined by the State Department standards.

VI. STATUS OF MATHEMATICAL MEKONG DELTA MODEL

39. Review of Status. - On 5 through 7 October 1964 the team met with representatives of the Société Grenobloise d'Études et d'Applications Hydrauliques (SOGREAH). Those contacted included Messrs. Francis Biesel, Director of the Scientific Division; H. Lorgeré, Engineer in Charge, Mekong Delta Program; Preissman, Chief Computer Programmer, Mekong Delta Model, and Cunge, Programmer, Mekong Delta Model. Although Mr. Lorgeré is in charge of the program for SOGREAH he reports, in this particular instance, to Mr. Francis Biesel, Director of the Scientific Division, who also supervises the computer activities of the organization.

Their computer at present is an IBM 7070 with associated peripheral equipment, including magnetic tape drives. Mr. Lorgeré's knowledge and background on physical hydraulic models should prove invaluable in arriving at a good solution to the Mekong Delta Model problem. A copy of the organization chart of SOGREAH is attached as Appendix K. According to the observations of the team, the work of SOGREAH is proceeding very nicely. They have the Delta divided into several hundred key points for observation and forecasting. Their approach to the solution of the problem is oriented more toward the theoretical mathematical side but it still involves the application of certain empirical relationships established through field observations. On examination of some of the reaches of the Delta and some of their runs on forecasted flows and stages, their verification appears to be very good. With the obtaining of additional field information through this past flood season and the next flood season their program no doubt will be greatly improved.

40. In particular, Mr. Biesel and Mr. Lorgeré were most cooperative in explaining and demonstrating to the team their approach to the solution of the problem and examples of certain areas of verification. Similarly, the rest of the organization was very cooperative. It is the opinion of the team that SOGREAH will produce a mathematical model which will yield reasonable results. The computer program will be written in FORTRAN and will finally be debugged and on an IBM 360/40 or 50 either during the spring of 1965 or the spring of 1966, depending on the instructions they receive from UNESCO. The instructions from UNESCO depend on whether or

not a decision is reached to complete the writing of the program in FORTRAN now, and then modify it as a result of field data obtained during the high water season of 1965, or to await completing the program in FORTRAN until after the field data are obtained for the 1965 high water season. If the latter decision is invoked this would mean the program would not be completed until the late summer or fall of 1966 as compared to completion in the late summer or fall of 1965 if they go ahead in accordance with the former alternative and then modify the program to take into account the field data for the high water season of 1965.

41. Computer Used. - SOGREAH has placed with IBM an order for an IBM 360/40 or 50. It is scheduled by IBM for delivery in the fall of 1965. The exact configuration of the system has not been decided as of this date. In view of this circumstance and the situation at Bangkok (National Statistical Office), the writing of the program in FORTRAN is very logical.

42. Input for Delta Model. - To couple or combine the river program with the delta program, SOGREAH needs as an input to their program the mean daily flows with regard to time for the entire flood season. In other words, the input must involve two factors, time as the abscissa, and the mean daily flows in cubic meter per second for Kratie or some point downstream therefrom as the ordinate.

43. In the model for the Mekong Delta, SOGREAH has included the Grand Lake and the discharge control features of the Tonle Sap project for flood control and other purposes can be made a part of the program. With the flow reconstitution program developed by the Corps for the

Grand Lake, the inflows to the Lake can be reconstituted for a 30-year period. These inflows then can be used as an input item to the SOGREAH program and the effect of either the Grand Lake or the Tonle Sap project on the flood flows into the Delta can be determined. This aspect of the program is important to the engineers from India who will have to work up rule curves for the operation of the Tonle Sap project. As it now stands, these rule curves would have to be predicated on known flood flows for about six years since the start of the Harza program. The flow reconstitution as cited above will enable flood flows to be computed for some 30 years and the rule curves can then be based on a much longer period. In addition, the flow reconstitution program can be used for flood forecasting on future floods when combined with the SOGREAH program. For these reasons the engineers of the Government of India will have a keen interest in the successful culmination of the training program which will then permit them to better analyze the effects of the Tonle Sap project and the flood control benefits to be realized in the Delta area, as well as the lake or reservoir elevations which may be expected in the Grand Lake.

44. On 9 October the team met with Professor Zanobetti at his UNESCO office in Paris, France. Dr. Zanobetti is the manager of the contract which UNESCO has with SOGREAH for the construction of the mathematical Delta Model. Considerable discussion was had with Professor Zanobetti relative to the model, in particular UNESCO's training in general. The team reported to the Professor that it was pleased with the procedure which SOGREAH was using in solving the problem and

gratified to learn of SOGREAH's progress since the time of the last visit there in May 1963. Professor Zanobetti stated he prefers to complete the mathematical model, using the flood years of 1963 and 1964 for verification and to continue obtaining field data for the 1965 flood season. The program or model subsequently would be modified as indicated by the 1965 flood data. The alternative would be to stop work on the model programming in FORTRAN until the 1965 flood season data are obtained and then complete the model. Professor Zanobetti was advised that the team concurs with his views on this problem, mainly due to the fact that a usable mathematical model would be available in the late summer or early fall of 1965. In addition, there is no guarantee that the flood runoff in the 1965 season will be substantially higher than what was experienced in either 1963 or 1964. Professor Zanobetti informed us that a meeting of the consultants to the model program was being held in late October and a decision on the matter of completing the mathematical model programming would be made at that time.

45. The training of engineers in the program envisioned by the 1963 report was discussed in general with Professor Zanobetti. He is very skeptical that the program will be anywhere near 100 percent successful. His view is that if 25 percent of the candidates are well trained, we have succeeded. SOGREAH has had five trainees in conjunction with the Delta Model at Grenoble for training. Three of these engineers were Vietnamese and two were Cambodians. Their success in training these engineers was not what they had hoped for. His views in this area were somewhat shared by SOGREAH. In fact, it is his feeling and that of

SOGREAH that the proposed Corps of Engineers program should be longer for successful training, in the area of two years rather than one. He stated it had been his experience that engineers are not qualified as comprehensively as required in the field of hydraulics and hydrology. In other words, it has been his experience that the candidates appear for training with somewhat of a negative attitude from the very beginning, as a result of the cultural and social shock of a new environment. They are doing it because they have to rather than because they want to, and this is not conducive to successful accomplishment of a given training mission. His view also was shared by engineers from SOGREAH. The above situation indicates that extreme care should be used in screening the candidates in order to select, insofar as possible, those that are best qualified and who have the proper attitude toward the overall program.

46. At the time the model for the Lower Mekong River and the Delta are coupled together on the computer, it appears that it would be very desirable to have an engineer from SOGREAH at the North Pacific Division Office, such as Mr. Lorgeré or someone equally well qualified, to be present and assist with this difficult task. This person should plan to stay at least two months. It is the concensus of the team, SOGREAH, and Dr. Zanobetti that the two models can be coupled together to produce the desired results. The task at best will not be easy, but it will be simplified if the above procedure is followed. Conversely, at SOGREAH, when they join the two models together, someone such as Mr. Rockwood or one equally qualified in this particular area should be present to assist SOGREAH people in the coupling of the two models together on their

computers. Since it is apparent that the two computers that may be in use at that time will be IBM 360's, or ones equally compatible, the problem will be somewhat simplified. This particular matter was brought up with people from the Office, Chief of Engineers, as well as with people in the State Department, and no adverse comments were made at that time on this suggestion.

47. Professor Zanobetti discussed and made a suggestion that it might be well for UNESCO to establish a training program under its supervision for engineers and scientists to train them in the use of computers for solving problems in areas of these fields and to provide them with a good background to undertake a training program like that presently envisioned for the riparian countries of the Mekong. He inquired as to whether or not AID would be interested in this area of helping to co-sponsor a project of this nature. He was advised that this is a problem in the area of the responsibility and policy of the State Department and they would be advised of this situation, but it would be up to UNESCO and the State Department to follow through and crystallize any further action in this area. At the conference in the office of the State Department on 13 October, this subject was reviewed briefly and they were advised that for further action they might wish to contact the Washington, D. C., Liaison Office of UNESCO. The Officer in Charge is Mrs. Ann Moylan Brown at that office.

VII. DISCUSSIONS AND CONCLUSIONS

48. It is apparent to the team, and no doubt to others, as a result of the many contacts and discussions had with engineers and executives of high position almost throughout the world, that the undertaking and successful completion of the training program envisioned by the report of July 1963 will be difficult. The Corps of Engineers of the North Pacific Division possess the necessary talents, equipment and capabilities to successfully accomplish the mission, provided the candidates who are made available are properly trained technically, and possess the proper attitude, with at least 85 percent proficiency in English, both oral and written. The capability of each and every candidate to be able to comprehend and discuss the various aspects of the training program cannot be over-emphasized. To meet the qualifications of English comprehension and speaking may require intensive training in English prior to being made available for the training program. The responsibility for such a program is outside the purview of system analysis training. It is the firm belief of the team that AID should assume this responsibility. Before any candidates are accepted for training, their qualifications should be reviewed by the Corps of Engineers and their recommendations obtained prior to acceptance. Here again it is to be emphasized that the qualifications on English comprehension, both oral and written, should rest with AID.

49. The Committee for Coordination and Investigations of the Lower Mekong Basin, insofar as the team is concerned, accepted the proposal of the United States for the training program outlined in the report of

July 1963 and as presented by William J. Tonesk, Liaison Officer to ECAFE, without any reservations. The minutes of the 25th Meeting, however, should completely speak for the results in this area. In this regard, the Committee or the Government of Thailand must provide the necessary computer facilities. As heretofore discussed in this report, it is desired to modify the recommendation contained in the July 1963 report insofar as computer facilities are concerned. The concept of improving or expanding the IBM 1620 system at Chulalongkorn University should be abandoned because to make this computer acceptable for the system analysis program would require the expenditure of some $150,000. In addition, if this were not done the end product would be one which is inferior to the present generation of computers. The Committee should support the Thai Government's National Statistical Office, in justifying and obtaining an IBM 360/40 or 50, or equivalent, and make firm contractual arrangements to use this computer configuration for further system analysis work. Such procedure will provide a computer that is completely compatible with the one at SOGREAH and the one of the Corps of Engineers in the North Pacific Division. The writing of all programs in FORTRAN will make the programs easier to understand and easier to modify, and FORTRAN is completely acceptable to the IBM 360 or equivalent systems with practically no loss in computer efficiency. Such condition is not true of the IBM 1620.

50. As stated in the July 1963 report, the U. S. Army Engineer Division, North Pacific, at Portland, Oregon, has the necessary talent, personnel, equipment, and facilities required to successfully undertake

the contemplated venture of training of the riparian engineers in system analysis. The offer to undertake such a program should not remain open-ended indefinitely. Because commitments of the North Pacific Division associated with engineering activities of the Corps on its Civil Works Program are such that if the U. S. offer is not acted upon within two years of the date of the Committee's action of September 1964, the offer for training must be withdrawn.

51. The mathematical model of the Mekong Delta, as being created by SOGREAH under contract to UNESCO, is proceeding nicely. Writing of the program in FORTRAN and debugging it on an IBM 360 are desirable and further progress along this line is recommended by the team. At the time the two computer programs for the lower Mekong and its tributaries and the Delta are coupled together, the team feels it desirable and mutually beneficial if a representative of SOGREAH, such as one possessing the qualifications of Mr. Lorgeré, were to be made available to this office for a period of at least two months to assist in the coupling or joining of the two programs into one. Conversely, an engineer possessing the qualifications of Mr. Rockwood should be made available to UNESCO and SOGREAH so that their model can be joined with that for the Lower Mekong. The expenses of such an effort should be included as a part of the training program.

52. At this point it is proper to mention that it would be desirable for some of the top staff of the Committee and ECAFE to visit the office of the North Pacific Division, Corps of Engineers, in Portland during the end of the training program. By such a procedure these individuals

in a period of two weeks to a month could become familiar with the system analysis program and become knowledgeable in its workings, applications, and limitations. The expense of such a venture, however, is outside the purview of the training program and should be arranged either by ECAFE or the Committee.

53. In view of the many technical problems involved with the undertaking of the proposed training program and the details associated therewith, it is essential that the senior member of the team, Mr. Mark L. Nelson, be authorized to correspond directly with the several agencies involved in setting up this program. Such exchange of correspondence would be only for the purpose of clarifying technical aspects and would in no way infringe on any policy questions. Copies of such correspondence would be made available to all parties directly concerned. Authority to proceed in this manner is highly desirable. This question was discussed with personnel at the Washington level, both with the Corps and AID. No objections were voiced at that time to such a procedure.

VIII. RECOMMENDATIONS

54. It is the recommendation of the team that the following further course of action be adopted and pursued:

a. Plans for initiating the training program proceed in accordance with the unanimous acceptance of the U. S. proposal at the 25th Meeting of the Coordinating Committee, provided it is initiated not later than September 1966.

b. Before any candidate is accepted for training, he must demonstrate that he possesses an 85 percent proficiency in his knowledge

of English in accordance with the AID criteria.

c. Insofar as technical qualifications of any given candidate are concerned, a transcript of his college record, along with his detailed experience record, shall be furnished to the Corps of Engineers for its review and recommendations before he is accepted.

d. The Coordinating Committee join the Government of Thailand National Statistical Office in supporting, justifying, and obtaining an IBM 360/40 computer configuration, or equal, somewhat along the lines described by Appendix I, and that the Committee enter into a contract or agreement for the use or rental of computer time for system analysis work at the conclusion of the training program.

e. That UNESCO be encouraged to prevail on SOGREAH to complete the mechanical model for the Mekong Delta this year, programming it in FORTRAN and debugging on an IBM 360 based on verification from the data obtained from the flood seasons of 1963 and 1964 and then making such modifications as are indicated by the field data obtained during the flood season of 1965, thereby obtaining a workable mathematical model for the Delta one year earlier.

f. Prior to the departure of the candidates to be trained on the hydrological aspect of the program, all of the hydrologic data, particularly precipitation information, should be microfilmed and made available. These data should be obtained as discussed in paragraph 26 of the report.

g. As discussed in paragraph 27 of the report, Mr. Roger Berthelot, Staff Hydrologist, should accompany the trainees to initiate

the hydrology training program, and he should plan to stay for a period of about three months.

h. At the time the model for the lower Mekong and the Delta are coupled or joined into one, arrangements should be made for an engineer of SOGREAH to be present at Portland, Oregon, North Pacific Division Office to assist in the successful coupling of the two models into one. Conversely, an engineer from North Pacific Division should be present at SOGREAH in Grenoble, France, to assist with the same problem at the time SOGREAH couples the two models into one.

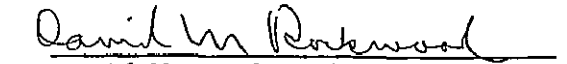
i. Arrangements be consummated with the Mekong Committee, its staff and ECAFE to have some of the high level engineers present near the end of the training program to familiarize themselves with system analysis.

j. The senior member of the team be authorized to correspond directly with the parties concerned with the implementation of the training program, solely on technical aspects, with copies of such correspondence to all those directly concerned.

IX. ACKNOWLEDGMENTS

55. Messrs. Mark L. Nelson and David M. Rockwood wish to thank all those who assisted with the many ramified problems associated with the initiation and implementation of the training program. The kind treatment and the many courtesies extended by all those involved are gratefully appreciated.

Mark L. Nelson
Chief, Water Control Branch



David M. Rockwood
Hydraulic Engineer (Research)
Water Control Branch

ENGCW-PP

3 June 1964

Mr. Robert Halligan
Thailand Regional Affairs
Agency for International Development
Room 4677, New State Department Bldg.
Washington, D. C. 20523

Dear Mr. Halligan:

Pursuant to your recent discussion with Mr. B. J. Witzig of this office, inclosed is a copy of a 1st indorsement dated 26 May 1964 from our North Pacific Division, concerning Corps of Engineers assistance in the proposed Mekong Systems Analysis Project.

The discussion in the inclosure covers questions resulting from the airgram of 24 April 1964 from USOM/Bangkok to AID/Washington. It is also relevant to the additional questions raised in the airgram of 20 May 1964 concerning inclusion in the training program of additional nationals from other than the Mekong countries.

As noted in the North Pacific Division indorsement, the training program costs in the Division would not be appreciably different for three, six or several more trainees. Due to increased computer costs of $25,000, since the report of July 1963 by Messrs. Nelson and Lewis, the total costs are now estimated at $223,000, of which $161,500 would be required as reimbursement to the Corps of Engineers.

If your Agency desires, Mr. Mark Nelson and Mr. David M. Rockwood, North Pacific Division, can be made available to attend the September meeting of the Mekong Committee in Bangkok, to assist in finalizing the training program and in advising on selection of the trainees. Return through Grenoble, France, to arrange for coordination with the SOGREAH studies of the Mekong delta would be desirable. The costs of this detail for Messrs. Nelson and Rockwood, including an elapsed time of not more than 30 days, is estimated at $7,000. Your Agency's advice on this matter would be desirable as soon as practicable to facilitate scheduling of other tasks in the Division Office.

Sincerely yours,

1 Incl
Cy 1st Ind NPDEN-WC, 26 May 64
w/basic ltr ENGCW-PP, 11 May 64
w/incl 2 and 3

JACKSON GRAHAM
Major General, USA
Director of Civil Works

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

August 8, 1964

Major General Jackson Graham
Director of Civil Works
Office, Chief of Engineers
Washington 25, D.C.

Dear General Graham:

SUBJ: Systems Analysis, Lower Mekong Basin
(Attn: ENGCW-PD)

Please refer in this matter to your letter of June 3, 1964.

The purpose of this letter is to confirm arrangements discussed by representatives of the Agency for International Development and the Corps of Engineers with respect to implementation of Recommendation No. 5 of the January 1962 report by Gilbert White and others on the "Economic and Social Aspects of Lower Mekong River Development", and with respect to the U.S. Army Engineer Division, North Pacific Division "Report on Computer Application to System Analysis".

In accordance with your letter of June 3, I request your authorization to permit Mr. Mark Nelson and Mr. David M. Rockwood, North Pacific Division, to attend the September meeting of the Mekong Committee in Bangkok and to return to the U.S. through Grenoble, France. It would be desirable for them to arrive in Bangkok during the week of September 14.

The terms of reference for the survey team are: (a) to interview the proposed participants to determine that their professional qualifications are consistent with Chapter VIII, Training, paragraph 82, page 46, of the Nelson and Lewis Report and to determine that the proposed participants would benefit from a systems analysis training program; (b) to obtain assurances, which will later be confirmed in the project agreement, from the Mekong Committee that the existing computer facilities in Bangkok will be available, modified and used in accordance with Chapter VII, Evaluation of Bangkok Computer Facilities, pages 37-43 and Chapter X, Conclusions and Recommendations, paragraph 100, page 54.

We have advised the Mekong Executive Agent that the costs of modifying or adding to the existing computer facilities will be part of the Mekong Committee or Thai Government contribution to the project; (c) to review the work being carried out by SOGREAH at Grenoble, France to insure the compatibility of the mathematical Delta model and the proposed Systems Analysis project to the computer facilities in Bangkok.

Messrs. Nelson and Rockwood would return through Washington to present their report to A.I.D. and the Corps.

Upon receipt of three signed and approved copies of this letter, $7,000 will be made available to the Corps of Engineers to cover salaries, per diem and travel of Messrs. Nelson and Lockwood for a period of approximately thirty days.

I want to thank you and your staff for your excellent cooperation in assisting AID to plan an effective Mekong System Analysis program.

Sincerely yours,

Rutherford M. Poats
Assistant Administrator, Far East

Approved: _____
Major General Jackson Graham

APPENDIX B

LOCATIONS & INDIVIDUALS CONTACTED BY TEAM

A. Tokyo, Japan, 7 and 8 September 1964

1. Mr. T. Yoshimatsu, Civil Engineer, Nippon Koei, Consulting Engineers
2. Mr. H. Yoshinaga, Civil Engineer, Nippon Koei, Consulting Engineers
3. Mr. R. Yoshida, Civil Engineer, Nippon Koei, Consulting Engineers
4. Mr. T. Hashimoto, Civil Engineer, Nippon Koei, Consulting Engineers
5. Mr. T. Tokuno, Civil Engineer, Electric Power Development Co., Ltd.
6. Mr. H. Hori, Civil Engineer, Electric Power Development Co., Ltd.
7. Mr. T. Takenouchi, Water Resource Development Corporation
8. Mr. Ni-i-nomi, Overseas Technical Cooperation Agency
9. Mr. M. Sugawara, Statistical Institute, Ministry of Education
10. Mr. Y. Shibata, Machinery Export, Dept. B., Mitsubishi Shoji Kaisha, Ltd.
11. Mr. K. Sugimoto, Machinery Export, Dept. B., Mitsubishi Shoji Kaisha, Ltd.
12. Mr. K. Jibiki, Machinery Export, Dept. B., Mitsubishi Shoji Kaisha, Ltd.

B. Taipei, Taiwan, 10 thru 13 September 1964

1. Mr. Cheng-Fong Hsu, Vice President and Director, Taipower Technical Mission to Vietnam, Taiwan Power Co.
2. Mr. W. K. Ku, Chief Engineer and Vice-President, Taiwan Power Company
3. Mr. David S. L. Chu, Taiwan Power Company
4. Mr. Pu, Taiwan Power Company
5. Mr. C. S. Huang, Taiwan Power Company
6. Mr. C. L. Chang, Taiwan Power Company
7. Mr. Siang-Hu Huang, Chairman, Water Resources Planning Commission, Ministry of Economic Affairs
8. Mr. F. Y. Liu, Taiwan Provincial Water Conservative Bureau
9. Mr. William Tessitor, Power Director AID/Taiwan
10. Mr. P. T. Tan, ECAFE, Bangkok
11. Mr. H. N. Walker, Project Manager, U. N. Special Fund

C. Bangkok, Thailand, 15 thru 26 Sept. 1964

1. Mr. Tracy S. Park, Jr., Director, U.S. AID/Thailand
2. Mr. William J. Tonesk, U.S. Liaison Officer, ECAFE
3. Mr. Richard T. Whistler, Asst. Liaison Officer to ECAFE
4. Mr. Hugh F. Tolley, Chief of Public Works, U.S./AID, Thailand
5. Mr. William F. Stephens, Liaison Officer for Mekong Project, U.S./AID, Thailand
6. Dr. C. Hart Schaaf, Executive Agent, Committee for Coordination of Investigations of the Lower Mekong Basin

7. Mr. Kanwar Sain, Director, Engineering Services and Member, Secretary of Advisory Board

8. Mr. P. T. Tan, Chief, Division of Water Resources Development, ECAFE

9. Mr. Roger Berthelot, Hydrologist, Mekong Office

10. Dr. Bundhit Kantabutra, Secretary-General, National Statistical Office

11. Dr. Boonrod Binson, Secretary-General, National Energy Authority, Thai Member on the Mekong Committee

12. Mr. Al L. Hunt, Jr., President, IBM Thailand Co. Ltd.

13. Mr. Everett Kimball, Jr., USOM

14. Mr. Norbert Ackerman, SEATO Graduate School of Engineering

15. Mr. John A. Roberson, SEATO Graduate School of Engineering

16. Dr. Ittipon Phadungcheewit, Professor in Charge of University Computer Center, Chulalongkorn University

17. Dr. D. Zanobetti, UNESCO, Paris, France

D. New Delhi, India, 28 and 29 September 1964

1. Mr. P. R. Ahuja, Chief Engineer and Joint Secretary, Ministry of Irrigation and Power

2. Mr. Pritam Singh, Central Water and Power Commission

3. Mr. K. V. Krishnamurthy, Central Water and Power Commission

E. Grenoble, France, 5 thru 7 October 1964

1. Francis Biesel, Director of Scientific Division, SOGREAH

2. Mr. H. Lorgeré, Engineer in Charge, Mekong Delta Program for SOGREAH

3. Mr. Preissman, Chief Computer Programmer, Mekong Delta Model

4. Mr. Cunge, Programmer, Mekong Delta Model

F. Paris, France, 9 October 1964

1. Dr. D. Zanobetti, UNESCO

G. Washington, D. C., 12 thru 14 October 1964

1. Office, Chief of Engineers, Personnel in Civil Works

2. State Department

Thomas C. Niblock, Director, Office of Southeast Asia Affairs

R. Halligan, FE/SEA/Regional

R. Watters, FE/SEA/Regional

Q. Wildman, FE/ENGR

G. Zimmerly, FE/DP

Agency for International Development

United States Operations Mission to Thailand

American Embassy. Bangkok, Thailand.

Dr. C. Hart Schaaf
Executive Agent
Committee for Coordination of Investigations
of the Lower Mekong Basin
Sala Santitham
Bangkok.

January 16, 1964

Dear Dr. Schaaf:

At the Twenty-third Session, Plenary of the Mekong Committee held in Bangkok 7-13 January 1964 the United States' delegate made a general statement of our views on the System Analysis Project. Since making this statement we have received more detailed information on our government's position toward carrying out the project.

These are presented in the paragraphs that follow. Will you please forward this information to the Committee Members.

The Agency for International Development endorses the Corps of Engineers' report on System Analysis. The report shows that sufficient data exists or can be developed to permit an analysis of an initial Mekong System and points up the importance of early implementation. We believe that the course of action and the training program recommended in this report are of high significance and will shape the Mekong program from that of a collection of projects to an integrated approach. This approach would analyze the interrelationships among separate projects and ultimately reach conclusions on the scale and scope of a Mekong system having maximum benefit for the basin as a whole.

With respect to the report recommendation, we are, subject to the Committee's request and availability of funds, favorably disposed to assisting the Committee in carrying out the report's recommendations. The request must necessarily contain assurances satisfactory to the points identified in the report as elements essential to success of the project namely:

1. Making available five or six suitable candidates, including two hydrologists, for a year's training at the Portland Center. Candidates should include nationals from all four riparian countries (see para. 81-82).

2. That the Committee intends to pursue a continuing program of system analysis after the training is completed (see para. 85), that the engineers trained by the Corps of Engineers will be assigned to the System Analysis program for at least three years after completion of their training (see para. 101) and that the trainees will train replacements if they should leave their positions thereafter.

3. That the Committee will work out with the Thai Government effective arrangements, preferably in writing, for the modification and use of the computer facilities in Bangkok as discussed in Section VII and para. 100. We assume that the costs of modifying or adding to the existing computer facilities for system analysis use will be part of the Mekong Committee or Thai contribution to the project.

We are pleased to advise you that the Agency for International Development is prepared, at the Committee's request, to invite Mr. Lewis and/or Mr. Nelson, authors of the System Analysis report, to attend your next session for the purpose of explaining and amplifying the report. If the Committee wishes to have either of these two experts attend the coming Tehran Session will you please let us know, by a letter, as soon as possible so that arrangements for their travel can be started right away.

Should you have any problems or questions concerning the System Analysis Project we will be glad to assist you in any way that we can.

Sincerely yours,

Tracy S. Park, Jr.
Deputy Director

MP/0263
TEC 322(2-2)

13 February 1964

Dear Mr. Park,

Thank you very much for your letter of 16 January 1964 concerning System Analysis Project. As you are aware, the Committee, at its twenty-third session in January 1964, decided to take action on the System Analysis Report at its future session; the nearest one (twenty-fourth) is to be held concurrently with the annual session of ECAFE at Teheran in March 1964 and the following one (twenty-fifth) is scheduled for 23-25 September 1964. We have given serious thought as to the appropriate time for the Mekong Committee to consider the report.

When the Committee holds its session concurrently with ECAFE, the main purpose is to provide an opportunity for the members of the Committee to establish contacts with various delegates attending the ECAFE annual session. The Committee, therefore, will not meet for more than 3 or 4 times during the entire ECAFE session and each meeting will not last for more than an hour, as most of the Committee's members will have to attend the ECAFE meetings. It is therefore not possible for the Committee to have any substantive discussions at all, and I therefore suggest that we do not try to take up this report during the Teheran meeting.

I understand from your letter that certain preparatory work will have to be taken care of in order to assure successful implementation of the project, such as the selection of suitable candidates for training. The Committee hopes that training of its personnel for such work in the North Pacific Division of the US Corps of Engineers can be initiated in 1964. I, therefore, have written to all members of the Committee to look for suitable candidates in their respective countries. In the meantime, I will discuss with the Committee's members, especially the Member for Thailand, the use and possible modification of computer facilities in Bangkok as mentioned in your letter.

I very much hope that all preparatory work can be completed within a few months' time so that an agreement can be entered into between AID and the Committee at the twenty-fifth session in September. We certainly would welcome the attendance at the September session of Mr. Nelson and/or Mr. Lewis, authors of the System Analysis Report, to explain and to amplify the project to the Committee.

Yours sincerely,

C. Hart Schaaf
Executive Agent

Mr. Tracy S. Park, Jr.
Deputy Director
USOM
Bangkok

UNITED NATIONS
ECONOMIC
AND
SOCIAL COUNCIL

LIMITED
E/CN.11/WRD/MKG/L.124 Rev.1
21 September 1964

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

Committee for Coordination of Investigations
of the Lower Mekong Basin
(Cambodia, Laos, Thailand and the Republic of Viet-Nam)
Twenty-Fifth Session (Special)
23 - 25 September 1964
Bangkok, Thailand

PROVISIONAL AGENDA

Part I: Working Session (including riparian delegations; co-operating countries and agencies concerned; Committee members and secretariat)
Committee Room No.4, Sala Santitham
Wednesday 23 September 1964: 9:00 to 12:00 hours; 14:00 to 17:00 hours
Thursday 24 September: 9:00 to 12:00 hours

Wed. A.M. 1. Opening

(a) Statement by Chairman
(b) Statement by Executive Secretary
(c) Statement by Executive Agent

Wed. A.M. 2. Adoption of Agenda

Wed. A.M. 3. Proposed assistance under discussion

(a) Navigation improvement: jet boats and training of mechanics and pilots (New Zealand)
(b) Navigation improvement: craft design, port improvement and river works (U.K.)
(c) Navigation improvement: delta barge and tug construction programme (France)
(d) Tributaries: Huey Bang Sai tributary in Thailand: soil survey (France)
(e) System Analysis (U.S.A.)
(f) Hydraulic physical models:
i. Quatre bras (UNESCO)
ii. Entire lower basin
(g) Tonle Sap project: quantitative study and recommendations seeking increased fish production in the Great Lake
(h) Possible technical study tour as part of the twenty-seventh session (New Zealand and Australia)

/4.

Wed. P.M. 4. Draft Plans of Operation to be considered for signature:

(a) Sambor mainstream project feasibility report: final phase of field investigations (Japan)
(b) Pilot training in Cambodian reaches of mainstream (Netherlands)
(c) Food support (WFP)
(d) Prek Thnot experimental and demonstration farm in Cambodia (Israel)

Thu. A.M. 5. Selected items of work in progress:

(a) Mathematical delta model (UNESCO)
(b) Experimental and demonstration farms:
  i. Battambang in Cambodia (FAO report)
  ii. Nam Ngum: Vientiane Plain in Laos (FAO report)
  iii. Kalasin in Thailand (FAO report)
  iv. Upper Sre Pok: Eak-Mat in Viet-Nam (FAO report)

(b) Mineral surveys:
  i. North-East Thailand and Laos: requested extension of Special Fund grant (secretariat report)
  ii. North-East Thailand: possible extension of U.K. Geo-Chemical Survey (U.K.)
  iii. Cambodia: requested Special Fund Bauxite Survey (secretariat report)

Thu. A.M. 6. Administration:

(a) Hydrologic spareparts programme (secretariat report)
(b) Contingency funds and special account (secretariat report)
(c) Petroleum products (secretariat report)

/Part II.

Part II: Working Session (Committee Members including riparian delegations, and secretariat)
Committee Room No. 4, Sala Santitham
Thursday 24 September 14:00 to 17:00 hours and
Friday 25 September 9:00 to 12:00 and 14:00 to 17:00 hours

7. UN Special Fund/ECAFE/Mekong Committee institutional support project: Proposed Work Programme and budget for 1965

8. Financial progress reports:

   (a) Nam Ngum in Laos (Member for Laos, Chairman, and Executive Agent)
   (b) Prek Thnot in Cambodia (Member for Cambodia)

9. Construction Progress Reports:

   (a) Prek Thnot (statement by Member for Cambodia)
   (b) Nam Dong (statement by Member for Laos)
   (c) Se Done (statement by Member for Laos)
   (d) Nam Pong (statement by Member for Thailand)
   (e) Nam Pung (statement by Member for Thailand)

10. Advisory Board: Report and Recommendations of the Advisory Board following its meeting 19 April - 5 May 1964 (presentation of report by Member Secretary); items, dates and venue of next meeting

11. Seminars:

   (a) Navigation Improvement: Saigon 19/24 October 1964 (secretariat report)
   (b) Engineering: Nam Pong and Nam Pung project areas, 24 Nov./3 Dec. 1964 (secretariat report)

12. Public information

   (a) Mekong documentary film (secretariat report)
   (b) NHK/ABC (Japanese Broadcasting Station and Australian Broadcasting Station): Proposed three-month programme commencing 1 October 1964 in Cambodia to produce six TV documentaries (secretariat report)

13. Any other business

14. Confirmation of time and place of next sessions

UNITED NATIONS

22 September 1964

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

Committee for Coordination of Investigations
of the Lower Mekong Basin
(Cambodia, Laos, Thailand and the Republic of Viet-Nam)
Twenty-Fifth Session (Special)
23 - 25 September 1964
Bangkok, Thailand

PROVISIONAL LIST OF PARTICIPANTS

CAMBODIA:	Mr. Hok Peng Heang Vice President of the Bureau for Construction of Barrage	Chief of Delegation
	Mr. Peng-Ponn Chief of Administrative Bureau Direction of Public Works	
	Mr. Kim Chandarith Chief of Mining Office Ministry of Industry	
	Mr. Khiou-Bonthonn Director of Meteorology General Secretary of National Technical Commission for the Mekong	
LAOS:	H.E. Mr. Phouangkéoh Phanareth Consultant to the Minister Ministry of Public Works & Communications	Member for Laos
	Mr. Oukeo Souvannavong Commissioner of Planning	
	Mr. Issara K. Sasorith Deputy Director Hydraulics and Navigation	

/Thailand

THAILAND :	Dr. Boonrod Binson Secretary General National Energy Authority	Member for Thailand
	Mr. Nitipat Jalichan Deputy Secretary General National Energy Authority	Alternate
	Mr. Boochob Kanchanalak Special Grade Engineer Hydrology Section Irrigation Department	"
	Mr. Suthep Tingsabhat First Grade Engineer Hydrology Section Irrigation Department	"
	Squadron Leader Yoo Thongves Chief, Engineer Ministry of Industry	"
	Mr. Choowongs Dhanomkulbutra Chief, Divion of Agricultural Economics Office of the Under-Secretary of State Ministry of Agriculture	"
	Mr. Thalerng Thamrong-Nawasawat Acting Deputy Secretary-General Office of the National Economic Development Board	"
	Mr. Owart Suthiwart-Narueput Chief, International Economic Division Economic Department Ministry of Foreign Affairs	"
	Captain Sophon Tongkumvong R.T.N. Representative from the Hydrographic Department The Royal Navy	Observer

Thailand (Cont'd)	Mr. Tawatchai Rasanonta Representative from the Department of Technical and Economic Cooperation	Observer
	Mr. Ying Vajragupta Representative from the Department of Land Development	"
	Captain Charoen Charoenrajtabhak R.T.N. Representative from the Meteorological Department	"
	Mr. Phitaya Smutrakalin Representative from the Technical and Planning Office	"
	Mr. Jumchet C. Javanaphet Representative from the Department of Mineral Resources	"
	Mr. Sangob Kaewbaidhoon Counterpart Manager of the UN Special Fund Mineral Survey Project	"
	Mr. Thumnong Singalavanija Administrator, Office of the Agricultural Extension Administration	"
	Captain Viratana Sarindu R.T.N. Counterpart Manager of the Mekong Hydrographic Survey Project	"
	Phra Charoen Visavakom Director, Thai Committee for Coordination of Investigations of the Lower Mekong Basin	"
	Dr. Ittipol Phadungcheewit Chulalongkorn University	"
	Mr. Charin Attayotin Acting Chief, State Irrigation Division Irrigation Department	"

REPUBLIC OF VIETNAM :	Mr. Trinh-Ngoc-Sanh Permanent Secretary General National Mekong Committee
	Mr. Duong-Thanh-Dam Assistant to the Secretary General National Mekong Committee
AUSTRALIA:	Mr. A.H. Borthwick Liaison Officer of Australia to ECAFE Australian Embassy, Bangkok
FRANCE:	Mr. Alain Deschamps Permanent Representative of France to ECAFE French Embassy Bangkok
	Mr. Roux Chief, French Economic and Technical Aid Mission to Cambodia
	Mr. Pouillaude Mining expert
	Mr. Lem Deputy Permanent Representative
ISRAEL:	H.E. Mr. Yehiel Ilsar Ambassador Embassy of Israel Bangkok
	Mr. Haim Raphael Counsellor

JAPAN:	Mr. Shotaro Takahashi, Counsellor and Permanent Representative of Japan to ECAFE Japanese Embassy	
	Mr. Yoshio Hatano, Third Secretary and Assistant to Permanent Representative of Japan to ECAFE Japanese Embassy	
THE NETHERLANDS:	H.E. Mr. G.J. Dissevelt Minister Plenipotentiary and Permanent Representative of the Netherlands to ECAFE Royal Netherlands Embassy	
NEW ZEALAND:	Mr. R.J. Lawrence First Secretary and Permanent Representative of New Zealand to ECAFE New Zealand Embassy Bangkok	
UNITED KINGDOM	Mr. P.L. O'Keeffe First Secretary and U.K. Alternate Permanent Representative to ECAFE British Embassy Bangkok	
UNITED STATES	Mr. William J. Tonesk U.S. Liaison Officer to ECAFE American Embassy	Chief
	Mr. Richard T. Whistler Second Secretary and Assistant U.S. Liaison Officer to ECAFE American Embassy	
	Mr. William L. Stephens US/AID Mekong Project Liaison Officer	Advisor
	Mr. Mark L. Nelson, Chief Water Control Branch US Army Engineer Division, North Pacific Corps of Engineers	"
	Mr. David M. Rockwood US Army Engineer Division, North Pacific Corps of Engineers	"

/UNTAB

UN TAB and UN SPECIAL FUND	Mr. Alfred Edward, Deputy Regional Representative of UN Technical Assistance and Deputy Director of Special Fund Programmes in the Far East
FAO	Dr. H.N. Mukerjee Senior Regional Agricultural Officer (Soil Fertility, EPTA)
	Dr. S. Ong Regional Agricultural Officer (Farm Management)
WMO	Mr. Roger Berthelot Mekong Chief Hydro-meteorologist (Also member of the Office of the Executive Agent)
UNESCO	Professor D. Zanobetti, Director Division of Engineering and Technological Research (In charge of Mekong Delta Model Project) UNESCO, Paris
	Mr. F. Benet Deputy Project Engineer, Mekong Delta Model Project
ECAFE Secretariat	Mr. U Nyun Executive Secretary
	Mr. P.T. Tan, Chief Division of Water Resources Development
	Mr. William Tanzer, Chief Information Services
	Mr. Roger Krasker Interpreter/Translator

/Mekong

Office of the Executive Agent	Dr. C. Hart Schaaf Executive Agent
	Mr. Kanwar Sain, Director Engineering Services and Member Secretary of Advisory Board
	Mr. A.L. Van Riet, Director Navigation Improvement
	Mr. I. Macaspac Director of Economic & Social Studies
	Mr. M. Hayath Industries and Power Marketing Development Advisor
	Mr. H. Hedstrom, Project Manager UN Special Fund Mekong Minerals Survey
	Mr. R. Berthelot Chief Hydrometeorologist
	Mr. R.K. Basu, Chief Mekong Administrative Section
	Mr. P.R. Meuret Language Officer
	Mr. E.J. Lamache Administrative Assistant
	Mr. A. Sabillo Administrative Assistant
	Mr. Somphoon Pantitanonta Secretary

Statement
by
William J. Tonesk
Liaison Officer to ECAFE, American Embassy, Bangkok, Thailand

before

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
Committee for Coordination of Investigations of the Lower Mekong Basin
(Cambodia, Laos, Thailand and the Republic of Viet-Nam)
Twenty-Fifth Session (Special)
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Agenda Item 3 (e) - System Analysis (U.S.A.)

At the Committee's Twenty-third Session in January 1964, the United States representative stated our country's belief that the White Mission's Recommendation No. 5 concerning scale and scope studies of the Mekong development scheme can lead to a priority oriented project by project analysis of the many social, economic and capital projects you will be undertaking. Because of this interest, the United States indicated willingness to assist the Committee implementing Recommendation No. 5 of the White Mission Report.

Since there was some question as to whether sufficient data are available for a system analysis and whether system analysis would be useful at this stage of the Mekong investigation, the Executive Agent requested the United States Government to furnish several experts to study and make recommendations on implementing a system analysis project. To accomplish this study, the Agency for International Development provided two experts from the North Pacific Division, Corps of Engineers. As you will recall, two engineers, Messrs. David J. Lewis and Mark L. Nelson, were in Bangkok in April 1963 to evaluate and make recommendations on project implementation.

Following their field evaluation, the Corps of Engineers team prepared a report, Computer Application of System Analysis, Lower Mekong Basin, dated July 1963. This report has been distributed to you for study, consideration and comments.

In a letter dated January 16, 1964, our Government advised the Office of the Executive Agent that our position toward carrying out the project is as follows:

"The Agency for International Development endorses the Corps of Engineers' report on System Analysis. The report shows that sufficient data exists or can be developed to permit an analysis of an initial Mekong System and points up the importance of early implementation. We believe that the course of action and the training program recommended in this report are of high significance and will shape the Mekong program from that of a collection of projects to an integrated approach. This approach would analyze the inter-relationships among separate projects and ultimately reach conclusions on the scale and scope of a Mekong system having maximum benefit for the basin as a whole.

"With respect to the report recommendation, we are, subject to the Committee's request and availability of funds, favorably disposed to assisting the Committee in carrying out the report's recommendations. The request must necessarily contain assurances satisfactory to the points identified in the report as elements essential to success of the project, namely:

"1. Making available five or six suitable candidates, including two hydrologists, for a year's training at the Portland Center. Candidates should include nationals from all four riparian countries (see para. 81 & 82 of the System Analysis Report).

"2. That the Committee intends to pursue a continuing program of system analysis after the training is completed (see para. 85), that the engineers trained by the Corps of Engineers will be assigned to the System Analysis program for at least three years after completion of their training (see para. 101) and that the trainees will train replacements if they should leave their positions thereafter.

"3. That the Committee will work out with the Thai Government effective arrangements, preferably in writing, for the modification and use of the computer facilities in Bangkok as discussed in Section VII and para. 100. We assume that the costs of modifying or adding to the existing computer facilities for system analysis use will be part of the Mekong Committee or Thai contribution to the project."

Our January 16th letter to Executive Agent requested that the preceding information be forwarded to the Committee and offered to invite the authors of the System Analysis report to attend your next Session

to explain and amplify the report. The Executive Agent, in reply, said that his office would welcome the attendance of the report authors to this Committee Session. We are pleased to have with us today on our delegation two experts from the North Pacific Division Corps of Engineers. Mr. Nelson, Chief, Water Control Branch, is one of the authors of the System Analysis report. Mr. Rockwood is on the staff of the Water Control Branch and has charge of hydrologic research, with particular emphasis on the application of computers to solving complex hydrologic problems. While in Bangkok, Messrs. Nelson and Rockwood are inventorying basic data required for system analysis studies, evaluating capability of Bangkok electronic computers for system studies and interviewing potential candidates for training.

We have asked Mr. Nelson to summarize the findings presented in the July 1963 System Analysis report and to answer any questions the Committee might have on the subject.

Mr. Nelson:

Statement
by
Mark L. Nelson
U. S. Army Engineer Division, North Pacific

before

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
Committee for Coordination of Investigations of the Lower Mekong Basin
(Cambodia, Laos, Thailand and the Republic of Viet-Nam)
Twenty-Fifth Session (Special)
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Agenda Item 3 (e) - System Analysis (U.S.A.)

In April last year, I had the opportunity of coming to Bangkok to examine the possibility of introducing the use of electronic computer for system analysis in planning the Lower Mekong river development. The purpose of my previous visit was essentially (1) to evaluate the adequacy of available basic data required for system analysis, (2) to evaluate the computer facilities available in Bangkok, and (3) to determine whether training of engineers in system analysis can best be accomplished in Bangkok or in U.S.A. My findings are contained in the report entitled "Computer Application to System Analysis, Lower Mekong Basin" which was presented to the members of the Committee at the January session this year. I am sure my report has been reviewed by your technical departments. I am very happy to take this opportunity to briefly explain to you the program we have in mind to assist you in planning your development projects.

As mentioned in my report, we found out that you either have or can get the necessary data and information to proceed with system analysis. In so doing, you will be able to take advantage of all the work the Army Engineers of the U.S.A. have been doing over the past 9 years in this very field for the Columbia River in the Northwestern part of the United States. Strange as it may seem, these two great rivers are very similar in their regime. If a project agreement between the Committee and AID is consummated the Army Engineers will be most happy to train your people so that you will then be more able to help yourselves in the latest techniques for basin planning and selecting an optimum plan of water resource development.

The concept of system analysis of a group of interrelated multiple-purpose projects for a complex river basin is described in the report which we prepared for the Lower Mekong in July 1963. To refresh your memory I will review for you just how an electronic computer functions to help in solving the problem.

A program is prepared for the computer that in a sense creates and defines the many characteristics of a given system of projects. For instance, on the Columbia River in the Northwestern part of the U.S. where we have been making system analyses on an electronic computer for the past 9 years, we can analyze as many as 60 multiple purpose projects wherein about one-third are storage projects and the remainder are run-of-river projects with only pondage for power in them. The computer does the same thing that an engineer would do in making a regulation by hand methods and a desk calculator, but instead of taking months up to a year, it will do it in minutes. The speed at which the computer calculates for a single computation is in terms of millionths or billionths of a second. With these speeds, one is able to make many trial and error computations readily and bracket or approach towards optimization of a given regulation is rapidly approached. Also, it permits the engineer to evaluate many combinations and permutation of development for either a system or a given project that would be practically impossible using conventional hand methods.

For system power studies normally a period of 20 to 30 years is studied using average monthly flows. The optimum use of the storage is determined for power purposes. Requirements for irrigation, navigation, flood control and any other multiple-purpose uses are taken into account by building these limitations or restrictions into the program or model. Tests can be made to be sure that pondage limitations or rate of change in flow and stage are not violated by using a program which analyzes the river in hourly increments of time.

The hydrologic analysis performed by the computer also involves the concept of a simulated river model, but in this case, the model may represent the character of runoff from rainfall from each tributary basin, the characteristic of travel of floods through each channel reach, and the storage and outflow characteristics of reservoir projects. With this model, and with the necessary coefficients derived to represent the Lower Mekong River and its tributaries, it is feasible to simulate any desired condition of streamflow under unregulated conditions, or to superimpose the effects of storage projects and derive regulated streamflows at downstream points. These are normally computed for relatively short time intervals (usually a day, or less), and the entire streamflow variation with time is developed for as many as 30 or 40 locations or tributaries, in a very few minutes on the computer, for a period of a month

or more of flow record. This computer program or model then can be applied to a number of different uses, including derivation of historic streamflow data from rainfall records, reservoir regulation studies for flood control and other purposes, flood forecasting on a day-to-day basis during the high-water period, and for design flood studies which are necessary for engineering design to assure the safety of the project. The streamflows derived for the lower river at Kratié may then be used as input data for the UNESCO or SOGREAH model of the delta area, and thereby derive regulated or natural river levels for the key points in the delta.

It is desired to amplify some of the statements made by Mr. Tonesk to stress the importance of these points as related to system analysis through the use of an electronic computer. The items I have in mind in particular are:

(a) The obtaining of all possible precipitation and streamflow records for all stations throughout the basin.

(b) The obtaining of the Computer Program developed by SOGREAH under contract to UNESCO for a mathematical model of the Mekong Delta, together with all supporting data as program write-up, logic statements, flow chart or diagram and other relevant information.

(c) The continued diligent prosecution of the Committee staff and others on the collection and compilation of basic data as envisioned by the Committee in its Five Year Program and Financial Plan for 1964/68 under U. N. Special Fund Institutional Support Project. Information in this category includes, for example, project layouts, cost estimates, mapping, geologic and foundation data, patterns of irrigation diversion extent and amounts, return flow, minimum flow requirements for the several purposes to be served, including that required for navigation and salt-water intrusion, power market surveys regional and potential world markets, and data on which to base or measure the benefits to be realized through the several functions to be served to permit an overall economic analysis and the determination of a benefit-cost ratio for the project or projects of the system.

With your indulgence I would like to discuss in some detail each item. Streamflow, of course, is basic to any system analysis of a series of multiple purpose projects. A longer record should be used for analysis than that which is presently available for the Lower Mekong Basin and its tributaries, as the result of the program initiated through the Contract with Harza and since continued by the four riparian countries and the Committee staff. For this work you are to be complimented. We, however, must develop a period of record for about 25 years. This we feel can be done by use of the computer program or model of the river which we will create for you

and train your engineers in the use of this new tool. To go back in time, however, we must, and I repeat must, have all the daily hydrologic data available--precipitation, streamflow and river gage height--for all stations.

The computer program developed by UNESCO thru SOGREAH we must have, together with all its supporting data, so that we can couple the two mathematical models together into one, so that flows and stages for the entire river, including the Delta, can be developed. This coupling together of the two models is essential to permit your engineers on their return home to make flood forecasts on a daily basis throughout the flood season. It also will permit complete analysis to be made of the effects of the Great Lake, either with or without the Tonle Sap project. The combined model can be used to test many things insofar as determination of flows and their regulation by any given combination of projects.

The reason for special recognition and emphasis to the basic data collection and analysis is that on the return of your engineers, they will need these data to make more meaningful system analyses and to better determine the effects when any given variable is changed or modified. I know you all are aware of the importance of this work, but I would be remiss if I didn't emphasize it here. More refined data I am sure will permit you to develop an overall basin plan that is comprehensive in nature, where all the pieces dovetail together. It also should permit you to select some of the smaller projects requiring less capital expenditure, but fitting into the overall basin plan and then leaving the larger ones requiring greater capital outlay for later development as your overall economy grows to the degree necessary to require the development of the larger projects. Work in the basic data field must be relentlessly continued and pursued.

Should you have questions on any of the subjects I have discussed, I will be happy to answer them. Thank you.

MEMORANDUM TO: Mr. William J. Tonesk
U. S. Liaison Officer to ECAFE

Mr. William L. Stephens
Mekong Project Liaison Officer

Date: Sept. 18, 1964

SUBJECT : Computer Application to System Analysis of Lower Mekong

In connection with the assignment of the undersigned and Mr. D. M. Rockwood to Bangkok to assist AID in the problem of computer application to system analysis of the Lower Mekong River, it is desired to stress the importance of two significant aspects of the problem.

First, positive measures and means must be established to obtain daily precipitation records of all stations throughout the entire basin for the past 30 years. It is our understanding through the staff of the Mekong Hydrologist, Mr. R. Berthelot, that these data are available, but it will require visits to the four riparian countries to copy or microfilm this information. Along with this precipitation data, daily records for all river gages should be obtained for the same period. These data are essential for the flow reconstitution work.

Second, definite arrangements should be made by the proper party or parties for us to obtain the computer program developed by SOGREAH for the Mekong Delta, together with all supporting and back-up material, including but not necessarily limited to all logic statements, flow diagrams and related items. These data are necessary to combine the computer program for the Mekong River above the delta to the one for the delta in order to be able to analyze, forecast, reconstitute flows and stages for the entire river. This information we must obtain for the overall program to succeed.

Mark L. Nelson
Chief, Water Control Branch
U. S. Army Engineer Division,
North Pacific

30 April 1964

U. S. ARMY ENGINEER DIVISION, NORTH PACIFIC
CORPS OF ENGINEERS
210 Custom House
Portland, Oregon 97209

COMPUTER APPLICATION TO SYSTEM ANALYSIS LOWER MEKONG RIVER

Outline of Hydrologic Training Program for Streamflow Synthesis by Computer

SUMMARY

This training program will provide a thorough grounding of hydrologists of the riparian countries of the Lower Mekong, in the general concepts of the basic computer hydrologic model which can be derived for the Mekong River Basin. Initially, the training will be in the fundamentals of the model, and the training will be continued to its direct application to the hydrology of the Mekong River Basin. It will finally lead to the development of a 25-year record of daily streamflows synthesized from available meteorological data for key locations on the main stem of the Mekong and each of its major tributaries. These flows may then be applied to system analysis studies by Computer for flood operation, as well as power, irrigation, and other water use studies. Flood control studies also to be performed by the computer, would provide natural and regulated daily streamflows which can be used as input data to the computer model for the Mekong Delta, as programmed by SOGREAH. The model will also be useful in application to daily stream-flow forecasting in the Mekong River Basin. Finally, the streamflows developed for the basin for the 25-year period would provide sufficient data for determining the necessary streamflow statistics, whereby stochastic flows for long periods of time (e.g., 500 years or more) could be developed through use of an appropriate statistical model.

It is estimated that the entire training program will require 1 1/2 years. This includes the time necessary to develop the 25-year period of synthetic streamflows. The machine time required to accomplish the training and synthesize the streamflows is estimated to be approximately 650 hours on the IBM 1920 system, using program 24.J3.H001. The training would be accomplished in the North Pacific Office, under the direct supervision of Mr. David M. Rockwood, Hydraulic Engineer (Research), who would devote approximately one year of his time to the training and studies. It is assumed that each trainee will have speaking and writing knowledge of the English language.

SECTION A

BASIC HYDROLOGIC STUDY PROGRAM (one month)

I. Introduction to streamflow synthesis

A. General concepts

B. Basin hydrologic model

C. Storage concepts.

1. Basin

2. Channel

3. Lake or reservoir

II. Purpose and uses of streamflow synthesis by computer

A. Derivation of rainfall-runoff relationships, by reconstitution of observed streamflows

B. Derivation of historic basic streamflow data from meteorologic data for periods where streamflow records are lacking

C. Derivation of basic flood estimates for project design

D. Use in reservoir regulation planning studies

1. Flood control

2. Power regulation

3. Irrigation

4. Other water uses

E. Use for day-to-day streamflow forecasting and/or reservoir regulation

III. Discussion of basic hydrologic methods

A. Concept of hydrology as a science and art

B. Three broad phases of hydrology

C. Hydrologic cycle

D. Meteorological concepts as related to hydrology

E. Precipitation, its measurement and time-area-depth distribution

F. Evaporation and transpiration evaluation

G. Soil moisture evaluation

H. Streamflow and its measurement

I. Ground water flow and hydrograph analysis

J. Runoff time - distribution

1. Unit hydrograph

2. Storage routing

K. Streamflow routing in channels

1. Basic principle

2. Application to flood studies

L. Design floods

1. General principles

2. Examples

M. Reservoir regulation studies

N. Stochastic streamflow models

O. Flood and low-flow frequencies

SECTION B

STUDY PROGRAM OF ELECTRONIC COMPUTER METHODS IN STREAMFLOW SYNTHESIS, THROUGH USE OF PROGRAM 24.J3.H001 (3 months)

I. Introduction

A. General concepts of computer synthesis

1. Hydrologic model

2. Repetitive trial and error solutions

3. Requirements for practical solution

4. Review of methods used by others in USA

B. Capability in basin hydrologic application

C. Limitations

II. Summary of electronic computer techniques and equipment

A. General review of computer terminologies

B. Summary of genesis and development of electronic computers in USA

C. Computer operational concepts

1. Command structure

2. Linear programming

3. Information storage

4. Information input and output

5. Operation speeds

III. Electronic computer programming

A. General concepts

B. Brief course in computer programming for IBM 1920 system

1. SPS (symbolic programming system)

2. Fortran

IV. Detailed review of program 24.J3.H001, "Streamflow Synthesis and Reservoir Regulation, through use of ES-171 Technical Bulletin No. 22"

A. Hydrologic concepts

B. Computer techniques

C. Detailed program description

D. Basic data flow description

E. Principal sub-routines

F. Methods for specifying basin, channel, and reservoir storage characteristics

G. Methods for specifying hydro-meteorological data input

H. Data output

I. Computer operational techniques

J. Capabilities and limitations of program

V. Introduction to use of program 24.J3.H001 by hypothetical streamflow analysis

A. General concepts

B. Initiate and perform tests to familiarize the trainees with data processing techniques and hydrologic analysis techniques, using varying hypothetical streamflow conditions, within normal limits of hydrologic experience

1. Basin storage evaluation

2. Channel storage evaluation

3. Lake and/or reservoir storage evaluation

VI. Conversion of program from English to metric units

SECTION C

APPLICATION OF COMPUTER PROGRAM 24.J3.H001 TO BASIC HYDROLOGIC ANALYSIS FOR MEKONG RIVER (8 months)

I. General review of the hydrology of the Mekong River Basin

II. Review of basic data availabilities

- A. Streamflow records
- B. Precipitation records
- C. Other hydrologic elements

III. Subdivision of the drainages into homogeneous hydrologic units (probably 20 to 30 sub-basin areas and channel reach definition)

IV. Comprehensive study and development of rainfall-runoff relationships, basin storage coefficients, and channel storage characteristics, for 4 years of record (1960-1963), with check for consistency from year to year

- A. Derive basin outflows for each selected drainage basin, using existing observations of streamflow
- B. Select appropriate rainfall index stations
- C. Determine accumulated runoff vs. percent effectiveness curves
- D. Test by trial reconstitutions the ability to develop gaged time distribution of streamflow
- E. Adjust basin routing coefficients to obtain acceptable fit of data, including surface, subsurface, and base flow components

(Note: This item will require approximately 250 hours of IBM 1920 computer system machine time, and probably about 8 months to accomplish, within desired limits of accuracy.)

SECTION D

APPLICATION OF COMPUTER PROGRAM 24.J3.H001 TO DEVELOPING 25 YEARS STREAMFLOW RECORD, FOR SOME 30 to 40 KEY LOCATIONS ON MEKONG RIVER AND PRINCIPAL TRIBUTARIES (6 months)

I. General review of status of studies to this point

II. Application of basin routing coefficients, rainfall-runoff relationships, and channel routing coefficients, as derived in Section C, above, to observed daily precipitation index values, to derive daily streamflow values for each basin subdivision and key streamgaging stations at all major points in basin

III. Where long-period records are available for the main stem Mekong River, adjustments will be made to reconcile computed and observed flows.

IV. Over-all check on consistency with observed streamflow records, and basin-to-basin amounts

V. Derivation of basic streamflow statistics, using synthesized flows for 25-year period, for possible development of stochastic streamflow

VI. Trial simulation of streamflow by stochastic model

IBM

IBM Thailand Company Limited *101 Patpong Road, Bangkok, Thailand* *Tel: 34276 34480*

From the Office of the General Manager *Cable Address:* INBUSMACH

September 25, 1964

Mr. Mark Nelson
Chief, Water Control Branch
North Pacific Division
Corps of Engineers
210 Custom House
Portland 9, Oregon
U. S. A.

Dear Mr. Nelson:

I would like to express my appreciation to you for having had an opportunity to meet you here during your visit to Bangkok this week and discussed the possible utilization of an IBM Computer for the Mekong River Project.

In regards to the Mekong River Project, I would like to restate here certain of the alternative approaches and my recommendations. As we discussed, there are three possibilities as to the utilization of a computer on the Mekong River Project.

1) Upgrading and expanding the 1620 at Chulalongkorn University.

2) Separate installation of a computer for the Mekong River Project.

3) Share time with another computer user on a System 360.

As you know, the 1620 at Chulalongkorn University was purchased under an Educational Allowance Contract. This Contract specifies that the use of this computer is restricted to educational work by Chulalongkorn University and other educational organizations who offer degrees. If the 1620 should be upgraded for the purpose of utilizing it in connection with the Mekong River Project, Chulalongkorn University would be charged with responsibilities of reporting hours of such usage and reimbursing IBM on a 100% rental basis for each hour. In addition to this, the additional features which are being considered for the 1620 represent a major field alteration and are not considered feasible. Certain of the items require plant installation and could not be performed in the field. Therefore, it is my recommendation that this approach be reviewed once again in light of these considerations.

From our discussions, it appears unlikely that the Mekong Project would require sufficient machine hours to justify a separate computer installation for their sole use. Justification for such an installation would have to include use by other organizations.

The National Statistical Office has made some preliminary studies which indicate their requirement for a System 360. The possibility of purchasing time on such a System might well be the most plausible approach for the Mekong Project Committee to pursue. While this System has not yet been placed on order, a commitment by the Mekong Project to the National Statistical Office for utilization of a given number of hours would certainly seem to enhance the justification by the National Statistical Office and perhaps be an impetus to them to move on an immediate basis.

From our discussions, the utilization by the Mekong Project for such a System would be approximately forty hours per month. Also, as we discussed, the delivery time of a System 360 is currently two years after receipt of the order by New York and therefore, if the National Statistical Office and the Mekong Project Committee acted immediately, the delivery time of the System would coincide with the planned utilization by the Mekong Project.

In view of the above, I suggest that the Mekong Project Committee contact Dr. Bundhit Kantabutra, Secretary General of the National Statistical Office and outline its requirements for the use of a System 360. In view of the two years delivery cycle, such contact should be made at the earliest possible date.

Thank you again for the opportunity to discuss a possible utilization of IBM equipment in connection with the Mekong Project and if I can be of service to you in any way, please call on me.

Yours very truly,

A. L. Hunt, Jr.
General Manager

ALH:ks

IBM

IBM Thailand Company Limited *101 Patpong Road, Bangkok, Thailand* *Tel: 34276 34480*

From the Office of the General Manager *Cable Address:* INBUSMACH

October 8, 1964

Mr. Mark Nelson
Chief, Water Control Branch
North Pacific Division
Corps of Engineers
210 Custom House
Portland 9, Oregon
U. S. A.

Dear Mr. Nelson:

I am attaching a proposed System/360 configuration which we are submitting to the National Statistical Office. As we discussed in our meeting of September 25, 1964 with Dr. Bundhit Kantabutra, Secretary General of the National Statistical Office and Mr. Everett Kimball, Jr., USOM Adviser to the National Statistical Office; the National Statistical Office is presently considering utilization of a System/360. In this connection, I recommend that negotiations be made between the Mekong River Project Committee and the National Statistical Office for utilization of such a System/360 for the Mekong River Project computer requirements.

As I outlined to you in my letter of September 25, 1964, utilization of a System/360 at the National Statistical Office offers the best approach for the Mekong River Project of any of the approaches under consideration. The approaches under consideration being:

1) Upgrading and expanding the 1620 at Chulalongkorn University.

2) Separate installation of a computer for the Mekong River Project.

3) Share time with another computer user on a System/360.

The advantages of utilizing such a System/360 are as follows:

1) Greater computing power and versatility.

2) Compatibility with other advanced system which will be installed throughout the world.

3) Lowest cost per computation.

4) More rapid results from computations to the increased speed of the System.

5) Virtually unlimited ability to expand the System to meet additional requirements.

A System/360 configuration which is attached is built around a Model F40 main frame. This main frame can be expanded to 262 K in the field. It also has the ability to add up to 64 Multiplexer Channels for shared time operations of input, output, and compute units. A model F40 has a 1.25 micro speed access and move time per character. The control units in the configuration can handle additional tapes and disks (up to 7 tapes and 8 disk files). Additional control units may be added beyond this.

As we discussed, the System/360 has a two year delivery schedule after receipt of the order by New York office. In addition to this, approximately two months in transit time is required for shipment of the equipment to Thailand. In view of this and to tie in with the current schedule of computer utilization by the Mekong Project, I suggest that immediate action be taken by the Mekong River Project Committee with the National Statistical Office. I feel certain that an agreement by the Mekong River Project for utilization of our proposed System/360 at the National Statistical Office would be an impetus to the National Statistical Office to act immediately in regard to the proposed System/360.

Thank you for your interest in this matter and it was a pleasure discussing the computer requirements of the Mekong River Project with you during your recent visit to Bangkok. Please do not hesitate to call on us in any way that we can be of assistance to you in your analysis or implementation of methods to meet these requirements.

Yours very truly,

Al. L. Hunt, Jr.

cc: Dr. Bundhit Kantabutra - NSO, Bangkok.
Mr. Everett Kimball, Jr. - NSO, Bangkok.

Attachment

ALH:ks

PROPOSED SYSTEM/360 CONFIGURATION

FOR NATIONAL STATISTICAL OFFICE

Model	Description	Monthly Rental US$	Purchase Price US$	Monthly Maintenance
F40	System/360 CPU (64K)	5,115	253,705	140.00
	#3237 Decimal Arith.	120	5,160	1.75
	#4427 Fl. Pt. Arith.	100	4,300	2.50
	#7520 Storage Protection	160	6,400	1.50
	#4457 1401 Compatibility	535	24,395	16.00
	#1052 Printer Keyboard	65	2,930	6.50
2311-1	Disk Storage Drive	575	26,300	51.00
2841-1	Disk Storage Control	525	27,250	56.00
1402 N1	Card Read Punch	660	35,000	90.00
1403-3	Printer (1100 lpm.)	900	41,200	138.00
2821-1	Control Unit for 1402 & 3	1,045	49,500	42.00
3-2401-2	Three Tape Units (45 KC)	1,530	70,200	210.00
1-2403-2	Tape Control & Tape Unit	1,120	50,900	86.00
	Total US$	12,450	597,240	841.25

Note:
1. System/360 with high speed I/O devices (4 Tape/ 1 Disk / 1 Card Read Punch / 1 Printer)
2. Monthly prices apply only to purchase equipment. Rental prices include maintenance.

APPENDIX J

CURRICULUM VITAE

Name:	Sompong Chanvorapab
Nationality:	Thai
Address:	National Energy Authority Bangkok, Thailand
Date of birth:	1935
Marital status:	Single
Languages:	English (good)
Education:	
1954 - 1960	Chulalongkorn University (Hons) B.Sc. in Civil Engineering
1962 - 1963	M.Sc. SEATO Graduate School of Engineering
Experience:	
1961 - 1962	Jr. Engineer in hydrologic work
1964 - present	Jr. Engineer in hydrologic work at Mukdahan Station
Professional Association:	Member of Engineering Institute of Thailand

CURRICULUM VITAE

Name:	Wera Weesakul
Nationality:	Thai
Address:	National Energy Authority Bangkok, Thailand
Date of birth:	September 18, 1938
Marital status:	Single
Languages:	English (fluent)
Education:	
1948 - 1954	Bangkok Christian College
1954 - 1956	Chulalongkorn Pre-University School
1956 - 1960	Chulalongkorn University B.Sc. (Hons) in Civil Engineering, April 1960
1960 - 1962	M.Sc. in Civil Engineering, SEATO Graduate School, April 1962
Experience:	Structural Engineer, Technical Division, National Energy Authority, Ministry of National Development. In charge of design and construction of various structures.
	Deputy project engineer of Nampong Project.
Professional Association:	Member of Engineering Institute of Thailand.
	Member of American Concrete Institute.

CURRICULUM VITAE

Name:	Chanchai Wongthai
Nationality:	Thai
Address:	National Energy Authority Bangkok, Thailand
Date of birth:	September 24, 1935
Marital status:	Single
Languages:	English (good)
Education:	
1946 - 1952	Yothinburana
1952 - 1954	Chulalongkorn Pre-University College
1954 - 1961	Chulalongkorn University B.Sc. in Civil Engineering
Experience:	
1961 - 1962	Assigned to Harza Engineering Company International as a Jr. Hydraulic Engineer in connection with the analysis of hydrologic data.
1962 - 1963	Jr. Engineer, Technical Division in charge of Sediment Laboratory, Deputy Chief of Mudahan Regional Office in the hydrologic investigation of Mekong River.
1964	Jr. Engineer assigned to U. S. Bureau of Reclamation in connection with soil survey of Pa Mong Project.
Professional Association:	Member of Engineering Institute of Thailand.

CURRICULUM VITAE

Name:	Le Long
Nationality:	Vietnamese
Education:	Diploma, Engineer of Public Works of Saigon University, 1954
	MS in Civil Engineering, Purdue University, 1962
Experience:	Engineer, Division of Roads, Ministry of Public Works
	Trainee in Mathematic model at Grenoble

NOTE: The Government is looking for two freshly graduated Vietnamese engineers with U.S. degree to take part in the training, if Le Long is not available.

SOGREAH

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APPENDIX K
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